WHAT IS CLAIMED IS:

1. A coding apparatus for carrying out serially concatenated code modulation with respect to data input comprising:

a first coding means for carrying out coding whose code rate is k/(k+1) with respect to data of k-bit input;

a first interleaving means for interleaving order of bits constituting data comprising a bit series of (k+1) bits coded by said first coding means;

at least one or more second coding means serially concatenated with the later stage away from said first interleaving means to carry out coding whose code rate is 1 with respect to data of (k+1) bit input;

at least one or more second interleaving means serially concatenated with the respective ones of said at least one or more second coding means to interleave order of bits constituting data comprising a bit series of (k+1) bits coded by said second coding means in the first stage;

a third coding means serially concatenated with the second interleaving means in the final stage to carry out coding whose code rate is 1 with respect to data of (k+1) bit input; and

a mapping means for mapping data of (k+1) bit coded by said third coding means to a transmission symbol of a predetermined modulation.

2. The coding apparatus according to claim 1 wherein said first coding means, said second coding means, and said third coding means respectively carry out convolutional

operation with respect to data input.

3. The coding apparatus according to claim 2 wherein at least said second coding means and said third coding means respectively carry out recursive systematic convolutional operation with respect to data input.

4. The coding apparatus according to claim 1 wherein said first interleaving means and said second interleaving means are respectively random interleavers.

5. The coding apparatus according to claim 1 wherein said mapping means carries out modulation according to a 8-phase shift keying.

6. A coding method for carrying out serially concatenated code modulation with respect to data input comprising the steps of:

first coding whose code rate is k/(k+1) with respect to data of k-bit input;

first interleaving order of bits constituting data comprising a bit series of (k+1) bits coded by said first coding step;

carrying out at least one or more processes including a second coding step for coding whose code rate is 1 with respect to data of (k+1) bit input and a second interleaving step for interleaving order of bits constituting data comprising a bit series of (k+1) bits coded by said second coding step;

third coding whose code rate is 1 with respect to data of (k+1) bit processed by said carrying out step; and

mapping data of (k+1) bit coded by said third coding step to a transmission symbol of a predetermined modulation.

7. The coding method according to claim 6 wherein said first coding step, said second coding step, and said third coding step respectively carry out convolutional operation with respect to data input.

8. The coding method according to claim 7 wherein at least said second coding step and said third coding step respectively carry out recursive systematic convolutional operation with respect to data input.

9. The coding method according to claim 6 wherein said first interleaving step and said second interleaving step are respectively carried out by random interleavers.

10. The coding method according to claim 6 wherein said mapping step carries out modulation according to a 8-phase phase modulation.

11. A recording medium having recorded a code program capable of being controlled by a computer for carrying out serially concatenated code modulation with respect to data input,

said code program comprising:

first coding whose code rate is k/(k+1) with respect to data of k-bit input;

first interleaving order of bits constituting data comprising a bit series of (k+1) bits coded by said first coding step;

carrying out at least one or more processes including a second coding step for coding whose code rate is 1 with respect to data of (k+1) bit input and a second interleaving step for interleaving order of bits constituting data comprising a bit series of (k+1) bits coded by said second coding step;

third coding whose code rate is 1 with respect to data of (k+1) bit processed by said carrying out step; and

mapping data of (k+1) bit code by said third coding step to a transmission symbol of a predetermined modulation system.

12. A decoding apparatus for carrying out decoding of codes subjected to serially concatenated code modulation by coding equipment comprising: a first coding means for carrying out coding whose code rate is k/(k+1) with respect to data of k-bit input; a first interleaving means for interleaving order of bits constituting data comprising a bit series of (k+1) bits coded by said first coding means; at least one or more second coding means serially concatenated with the later stage away from said first interleaving means to carry out coding whose code rate is 1 with respect to data of (k+1) bit input; at least one or more second interleaving means serially concatenated with the respective ones of said at least one or more second coding means to interleave order of bits constituting data comprising a bit series of (k+1) bits coded by said second coding means in the first stage; a third coding means serially concatenated with the second interleaving means in the final stage to carry out coding whose code rate is 1 with respect to data of (k+1) bit input; and a mapping means for mapping data of (k+1) bit coded by said third coding means to a transmission symbol of a predetermined modulation,

said decoding apparatus comprising:

a first soft-output decoding means provided corresponding to said third coding

means to carry out soft-output decoding using a reception word which is a soft-input input, and priori probability information with respect to information bits of (k+1) bits which is a soft-input input;

at least one or more first deinterleaving means serially concatenated with the later stage away from said first soft-output decoding means to rearrange data of (k+1) bits of a soft-input input so that a bit array of data of (k+1) bits rearranged by said second interleaving means is returned to a bit array of data of (k+1) bits coded by said second coding means;

at least one or more second soft-output decoding means provided corresponding to the respective ones of said at least one or more second coding means and serially concatenated with the respective ones of said at least one or more first deinterleaving means to carry out soft-output decoding using priori probability information with respect to code bits of (k+1) bits which are a soft-input output from said first deinterleaving means, and priori probability information with respect to information bits of (k+1) bits which are a soft-input input;

one or more third interleaving means for interleaving order of bits constituting data comprising a bit series of (k+1) pieces of a soft-input output from the respective ones of said at least one or more second soft-output decoding means on the basis of the same exchange position information as that of said second interleaving means;

a second deinterleaving means serially concatenated with the second soft-output decoding means in the final stage to rearrange data of (k+1) bits of a soft-input input

so that a bit array of data of (k+1) bits rearranged by said first interleaving means is returned to a bit array of data of (k+1) bits coded by said first coding means;

a third soft-output decoding means provided corresponding to said first coding means and serially concatenated with said second deinterleaving means to carry out soft-output decoding using priori probability information with respect to code bits of (k+1) bits which are a soft-input output from said second deinterleaving means, and priori probability information with respect to information bits of (k+1) bits which are a soft-input input; and

a fourth interleaving means for interleaving order of bits constituting data comprising a bit series of (k+1) pieces of a soft-input output from said third soft-output decoding means on the basis of the same exchange position information as that of said first interleaving means.

13. The decoding apparatus according to claim 12, further comprising a binary means for forming exterinsic information of a soft-output produced by said third soft-output decoding means into a binary form to output it as decode data of k-bit of a hard-output.

14. The decoding apparatus according to claim 12 wherein said first soft-output decoding means, said second soft-output decoding means, and said third soft-output decoding means respectively carry out maximum posteriori probability decoding based on the BCJR logarithm.

15. The decoding apparatus according to claim 12 wherein said first coding means,

said second coding means, and said third coding means respectively carry out convolutional operation with respect to data input.

16. The decoding apparatus according to claim 15 wherein at least said second coding means and said third coding means respectively carry out recursive systematic convolutional operation with respect to data input.

17. The decoding apparatus according to claim 12 wherein said first interleaving means, said second interleaving means, said third interleaving means, and said fourth interleaving means are respectively random interleavers.

18. The decoding apparatus according to claim 12 wherein said mapping means carries out modulation according to a 8-phase shift keying.

19. A decoding method for carrying out decoding of codes subjected to serially concatenated code modulation by a coding method comprising: a first coding step for carrying out coding whose code rate is k/(k+1) with respect to data of k-bit input; a first interleaving step for interleaving order of bits constituting data comprising a bit series of (k+1) pieces coded by said first coding step; a coding processing step for carrying out at least one or more processes including a second coding step for carrying out coding whose code rate is 1 with respect to data of (k+1) bit input and a second interleaving step for interleaving order of bits constituting data comprising a bit series of (k+1) pieces coded by said second coding step; a third coding step for carrying out coding whose code rate is 1 with respect to data of (k+1) bit processed by said coding processing step and input ; and a mapping step for mapping data of (k+1) bits coded

by said third coding step to a transmission symbol of a predetermined modulation system;

said decoding method comprising:

first soft-output decoding, corresponding to said third coding step, using a reception word which is a soft-input input, and priori probability information with respect to information bits of (k+1) bits which is a soft-input input;

carrying out at least one or more processes including a first deinterleaving step, a second soft-output decoding step and a third interleaving step with respect to data of (k+1) bits of a soft-input input;

a second deinterleaving step for rearranging data of (k+1) bits of a soft-input processed by said carrying out step input so that a bit array of data of (k+1) bits rearranged by said first interleaving step is returned to a bit array of data of (k+1) bits coded by said first coding step;

third soft-output decoding, corresponding to said first coding step, using priori probability information with respect to code bits of (k+1) bits which are a soft-input rearranged by said second deinterleaving step, and priori probability information with respect to information bits of (k+1) bits which are a soft-input input; and

fourth interleaving order of bits constituting data comprising a bit series of (k+1) pieces of a soft-input output produced by said third soft-output decoding step on the basis of the same exchange position information as that of said first interleaving step;

said first deinterleaving step rearranging data of (k+1) bits of a soft-input input so that a bit array of data of (k+1) bits rearranged by said second interleaving step is returned to a bit array of data of (k+1) bits coded by said second coding step;

said second soft-output decoding step being provided corresponding to the respective ones of said at least one or more second coding steps to carry out soft-output decoding using priori probability information with respect to code bits of (k+1) bits which are a soft-input output rearranged by said first deinterleaving step, and priori probability information with respect to information bits of (k+1) bits which are a soft-input input; and

said third interleaving step interleaving order of bits constituting data comprising a bit series of (k+1) pieces of a soft-input produced by the respective ones of said at least one or more second soft-output decoding steps on the basis of the same exchange position information as that of said second interleaving step.

20. The decoding method according to claim 19, further comprising forming exterinsic information of a soft-output produced by said third soft-output decoding step into a binary form to output it as decode data of k-bit of a hard- output.

21. The decoding method according to claim 19 wherein said first soft-output decoding step, said second soft-output decoding step, and said third soft-output decoding step respectively carry out maximum posteriori probability decoding based on the BCJR logarithm.

22. The decoding method according to claim 19 wherein said first coding step, said

second coding step, and said third coding step respectively carry out convolutional operation with respect to data input.

23. The decoding method according to claim 22 wherein at least said second coding step and said third coding step respectively carry out recursive systematic convolutional operation with respect to data input.

24. The coding method according to claim 19 wherein said first interleaving step, said second interleaving step, said third interleaving step, and said fourth interleaving step respectively carry out random interleave.

25. The coding system according to claim 19 wherein said mapping step carries out modulation according to a 8-phase shift keying.

26. A recording medium having recorded a decoded program capable of bing controlled by a computer for for carrying out decoding of codes subjected to serially concatenated coded modulation by a coding method comprising: a first coding step for carrying out coding whose code rate is k/(k+1) with respect to data of k-bit input; a first interleaving step for interleaving order of bits constituting data comprising a bit series of (k+1) pieces coded by said first coding step; a coding processing step for carrying out at least one or more processes including a second coding step for carrying out coding whose code rate is 1 with respect to data of (k+1) bit input and a second interleaving step for interleaving order of bits constituting data comprising a bit series of (k+1) pieces coded by said second coding step; a third coding step for carrying out coding whose code rate is 1 with respect to data of (k+1) bit processed by said coding

processing step and input; and a mapping step for mapping data of (k+1) bits coded by said third coding step to a transmission symbol of a predetermined modulation system;

said decoding program comprising:

first soft-output decoding, corresponding to said third coding step, using a reception word which is a soft-input input, and priori probability information with respect to information bits of (k+1) bits which is a soft-input input;

carrying out at least one or more processes including a first deinterleaving step, a second soft-output decoding step and a third interleaving step with respect to data of (k+1) bits of a soft-input input;

a second deinterleaving step for rearranging data of (k+1) bits of a soft-input processed by said carrying out step input so that a bit array of data of (k+1) bits rearranged by said first interleaving step is returned to a bit array of data of (k+1) bits coded by said first coding step;

third soft-output decoding, corresponding to said first coding step, using priori probability information with respect to code bits of (k+1) bits which are a soft-input rearranged by said second deinterleaving step, and priori probability information with respect to information bits of (k+1) bits which are a soft-input input; and

fourth interleaving order of bits constituting data comprising a bit series of (k+1) pieces of a soft-input output produced by said third soft-output decoding step on the basis of the same exchange position information as that of said first interleaving

step;

said first deinterleaving step rearranging data of (k+1) bits of a soft-input input so that a bit array of data of (k+1) bits rearranged by said second interleaving step is returned to a bit array of data of (k+1) bits coded by said second coding step;

said second soft-output decoding step being provided corresponding to the respective ones of said at least one or more second coding steps to carry out soft-output decoding using priori probability information with respect to code bits of (k+1) bits which are a soft-input output rearranged by said first deinterleaving step, and priori probability information with respect to information bits of (k+1) bits which are a soft-input input; and

said third interleaving step interleaving order of bits constituting data comprising a bit series of (k+1) pieces of a soft-input produced by the respective ones of said at least one or more second soft-output decoding steps on the basis of the same exchange position information as that of said second interleaving step.

27. The recoding medium having a decode program recorded according to claim 26 wherein said decode program comprises a binary step for forming exterinsic information of a soft-output produced by said third soft-output decoding step into a binary form to output it as decode data of k-bit of a hard-output.